THE MINERAL INDUSTRY OF SOUTH AFRICA

By Thomas R. Yager

The Republic of South Africa was one of the world's leading mining and mineral-processing countries. South Africa was the world's leading producer of andalusite, chromite, ferrochrome, gold, platinum-group metals (PGM), vanadium, and vermiculite, and the world's fifth ranked producer of rough diamond (Kweyama, 2005; Northwest Territories Department of Industry, Tourism and Investment, 2005, p. 6, 9; Amey, 2006; George, 2006; Papp, 2006, p. 17.22-17.23; Potter, 2006; Willett and Potter, 2006).

In 2004, South Africa's nominal gross domestic product (GDP) at purchasing power parity amounted to about $502 billion; the per capita GDP was about $10,800. The real GDP grew by 3.7% compared with 2.8% in 2003. The mining industry accounted for 7.1% of the GDP in 2004; primary and processed mineral products accounted for more than 35% of total exports. About 72% of primary mineral products and 75% of processed mineral products, by value, were exported in 2004 (International Monetary Fund, 2005, p. 212; 2005§[1]; Mwape and others, 2005, p. 8-9, 14, 17).

Commodity Review

Metals

Aluminum.—South Africa produced primary refined aluminum from imported alumina. National aluminum production increased to 863,000 metric tons (t) in 2004 from 738,000 t in 2003. BHP Billiton plc operated the Bayside and the Hillside primary aluminum smelters at Richards Bay. In 2004, production at the Hillside smelter increased to 680,000 t from 551,000 t in 2003 because of an expansion completed in December 2003. Production at the Bayside smelter declined to 183,000 t from 187,000 t (BHP Billiton Group, 2004, p. 2; 2005, p. 2).

Chromium.—In 2004, South Africa accounted for nearly 44% of the world's chromite production. National output of chromite increased to 7.68 million metric tons (Mt) in 2004 from 7.41 Mt in 2003. In 2004, South Africa's exports of chromite amounted to $45.2 million (Mining Journal, 2005; Papp, 2006, p. 17.22).

Xstrata plc of Switzerland and its joint-venture partners operated the Boshoek, the Chrome Eden, the Horizon, the Kroondal, the Thorncliffe, and the Waterval Mines, which had a total capacity of 6.19 million metric tons per year (Mt/yr) of chromite. At the Kroondal Mines, production increased to 2.13 Mt in 2004 from nearly 1.93 Mt in 2003; at the Thorncliffe Mines, to nearly 1.49 Mt from 1.34 Mt; and at the Waterval Mine, to 405,000 t from 46,000 t. Output at the Boshoek Mine was 253,000 t in 2004; the Horizon Mine, 123,000 t; and the Chrome Eden Mine, 23,000 t (Xstrata plc, 2005, p. 176).

Samancor Ltd. [a joint venture between BHP Billiton Group (60%) and Anglo American plc (40%)] operated the Eastern Chrome Mines in Mpumalanga Province with a capacity of 2 Mt/yr of chromite and the Western Chrome Mines in North West Province with a capacity of about 1.8 Mt/yr. In 2004, Samancor's production increased by 2.4%. About 75% of the company's output was consumed in its ferrochromium plants and the remainder was exported (Department of Minerals and Energy, 2004, p. 3, 5; Anglo American plc, 2005, p. 118; Samancor Ltd., undated§).

Assmang Ltd. of South Africa operated the Dwarsrivier Mine in Mpumalanga. In financial year 2003-04, production at Dwarsrivier increased to 648,000 t from 604,000 t in financial year 2002-03. Resources at Dwarsrivier amounted to 86.6 Mt at a grade of 38.7% Cr_2O_3, of which 27.1 Mt was reserves at a grade of 38.5% Cr_2O_3 (Assmang Ltd., 2004a, p. 12; 2004b).

Assmang planned to complete construction of an underground mine at Dwarsrivier to replace the open pit mine in 2005; total production of chromite was expected to be nearly 1 Mt. By 2007, the underground mine was expected to completely replace the open pit mine. By 2009, production was expected to exceed 1 Mt (Assmang Ltd., 2004b; Motsepe, 2005, p. 32).

South Africa was also the world's leading producer of ferrochromium, and accounted for 46% of world production in 2004. National production of ferrochromium rose to nearly 2.97 Mt in 2004 from 2.81 Mt in 2003 (Papp, 2006, p. 17.23).

Xstrata and its joint-venture partner Merafe Resources Ltd. of South Africa (formerly SA Chrome Ltd.) operated the Boshoek, the Gemini, the Lydenburg, the Rustenburg, and the Wonderkop ferrochromium plants. These plants had a total combined capacity of 1.62 Mt/yr. Production increased at Rustenburg to 393,000 t in 2004 from 322,000 t in 2003; at Lydenburg, to 393,000 t from 385,000 t; and at Gemini, to 173,000 t from 156,000 t. At Wonderkop, output declined to 311,000 t from 318,000 t. The Boshoek plant produced 218,000 t in 2004. In 2005, the total production of these plants was expected to increase to 1.59 Mt (Mining Journal, 2005; Xstrata plc, 2005, p. 176).

In December 2004, Xstrata and Merafe started construction on Project Lion, which was a new ferrochromium smelter with a capacity of 360,000 metric tons per year (t/yr). The project was expected to cost $264 million; Xstrata planned to start production in mid-2006 and reach full capacity in the fourth quarter of 2007. During the next 8 to 10 years, capacity could be increased by an additional 650,000 t/yr. Xstrata's share in the Lion Project was expected to be between 75% and 85% (Mining Journal, 2005; Xstrata plc, 2005, p. 8, 35).

Samancor operated the Ferrometals plant in Witbank, the Middleburg Ferrochrome plant in Middleburg, and the Tubatse Ferrochrome Plant in Steelpoort, which had a total capacity of 905,000 t/yr. In 2004, the company's production of ferrochrome rose

[1]References that include a section mark (§) are found in the Internet References Cited section.

to nearly 1.07 Mt from 1.02 Mt in 2003 (BHP Billiton Group, 2004, p. 4; 2005, p. 4; Department of Minerals and Energy, 2004, p. 21-22).

Assmang operated the Machadodorp ferrochromium plant in the Mpumalanga Province. In financial year 2003-04, production increased to 263,000 t from 222,000 t in financial year 2002-03 (Assmang Ltd., 2004b).

Copper.—In 2004, South Africa's mine production of copper decreased to 102,577 t from 120,800 t in 2003. Copper smelter production declined to 89,300 t from 112,025 t, and refined copper production declined to 91,498 t from 111,000 t. Copper exports amounted to $75.1 million in 2004 (Mining Journal, 2005).

Rio Tinto plc operated the Palabora copper mine, smelter, and refinery. In 2004, production at Palabora was 54,400 t of copper from 8.67 Mt of ore milled compared with 52,400 t of copper from 11.42 Mt of ore milled in 2003. The production of smelted copper at Palabora declined to 67,200 t in 2004 from 76,700 t in 2003, and the production of refined copper, to 67,500 t from 73,400 t (Rio Tinto plc, 2005, p. 19).

Anglo Platinum's production of refined copper from Rustenburg Base Metal Refiners remained unchanged at 12,900 t in 2004. About 12,200 t was attributable to Anglo Platinum's mining operations in 2004 compared with 12,800 t in 2003; the remainder was attributable to purchased concentrates (Anglo American Platinum Corp., 2005, p. 86, 88).

Metorex Ltd. of South Africa operated the Maranda copper-zinc mine and the O'okiep copper smelter. In the third quarter of 2004, Metorex shut down Maranda and O'okiep because of resource depletion (Metorex Ltd., 2004).

Gold.—South Africa was the world's leading producer of gold in 2004, accounting for about 14% of world production. However, the long-term decline in the country's gold output continued in 2004, with national gold production decreasing to 340,500 kilograms (kg) from 373,300 kg in 2003 and 430,800 kg in 2000. In 2004, gold exports amounted to $4.49 billion (Amey, 2006; Mining Journal, 2005).

AngloGold Ashanti Ltd. operated the Ergo Mine southeast of Johannesburg; the Great Noligwa, the Kopanang, the Moab Khotsong, and the Tau Lekoa Mines in the West Wits area near Carletonville; and the Mponeng, the Savuka, and the Tau Tona Mines in the Vaal River area near Klerksdorp. The company was formed by the merger of AngloGold Ltd. and Ashanti Goldfields Company Ltd. in 2004. AngloGold Ashanti's gold production declined to 95,800 kg in 2004 from 102,100 kg in 2003. Total cash costs rose to $291 per troy ounce of gold from $227 per troy ounce of gold; this increase was mostly attributable to the strength of the South African rand and inflationary pressures (AngloGold Ashanti Ltd., 2005, p. 23-24).

At the Mponeng Mine, production declined to 13,600 kg in 2004 from 15,500 kg in 2003 because of lower ore grades. At the Tau Tona Mine, lower ore grades and difficult mining conditions led to a decrease in production to 17,700 kg from 20,100 kg. Output declined to 4,900 kg from 5,800 kg at Savuka as the mine approached the end of its life. Cash costs at Savuka were $455 per troy ounce of gold in 2004. In 2005, production at the Mponeng Mine was expected to increase to 14,600 kg. Production at the Tau Tona and the Savuka Mines was likely to be 17,700 kg and 5,000 kg, respectively (AngloGold Ashanti Ltd., 2005, p. 24-25).

In 2004, production at the Great Noligwa Mine declined to 24,700 kg from 25,300 kg in 2003, and at the Tau Lekoa Mine, to 9,100 kg from 10,000 kg, because of lower ore grades. At the Kopanang Mine, output declined to 15,100 kg from 15,500 kg because of lower volumes mined. In 2005, production at Great Noligwa was expected to be 24,300 kg; Kopanang, 14,600 kg; and Tau Lekoa, 9,700 kg (AngloGold Ashanti Ltd., 2005, p. 26-29).

The Moab Khotsong Mine produced nearly 300 kg of gold in 2004. AngloGold Ashanti planned to start commercial production at Moab Khotsong in 2006 and to increase output to 15,600 kg by 2010. The mine was expected to produce 152,000 kg of gold from 7.75 Mt of milled ore during its 12-year life; capital costs were likely to be $651 million (AngloGold Ashanti Ltd., 2005, p. 28-29).

At Ergo, gold was recovered through the re-treatment of tailings. Gold production increased to 6,900 kg in 2004 from 6,300 kg in 2003 because of higher grades treated. Ergo was expected to shut down in 2005, however, because of the depletion of higher-grade content at the tailings dam (AngloGold Ashanti Ltd., 2005, p. 29).

Harmony Gold Mining Company Ltd. of South Africa mined gold at numerous mines that included the Elandsrand, the Evander, the Kalgold, the Orkney/Welkom, and the Randfontein. The company's production of gold was 89,598 kg in 2004 compared with 90,187 kg in 2003. The decrease in ore milled was mostly offset by an increase in grade to 4.48 grams per metric ton (g/t) gold in the fourth quarter of 2004 from 3.83 g/t gold in the same period in 2003 (Harmony Gold Mining Company Ltd., 2003, p. 25; 2004a, p. 24; 2004b, p. 31; 2005, p. 32).

In 2004, Harmony purchased a controlling share in the Target Mine from Avgold Ltd. The company planned to produce more than 18,000 kilograms per year (kg/yr) from the Target Mine. The Phakisa shaft project was expected to produce 8,700 kg/yr of gold. At the Tshepong Sub 66 Decline expansion project, gold production was expected to be 5,200 kg/yr starting in July 2006. The Masimong project produced gold at the rate of 7,800 kg/yr in the second half of 2003; Harmony planned to raise output to 9,800 kg/yr (Mining Review Africa, 2004a).

Gold Fields Ltd. of South Africa produced gold at the Beatrix, the Driefontein, and the Kloof Mines. In 2004, the company's production of gold was 87,744 kg from 16.4 Mt of ore milled compared with 89,860 kg of gold from 16.7 Mt of ore milled in 2003. In the second half of 2004, the ore grade was 5.6 g/t gold compared with 5.2 g/t gold in the second half of 2003. Production at the Driefontein Mine increased to 35,804 kg in 2004 from 35,607 kg in 2003. At the Kloof Mine, production declined to 32,884 kg from 33,754 kg, and at the Beatrix Mine, to 19,054 kg from 20,499 kg. Gold Fields planned to maintain production at Driefontein of 31,000 kg/yr; Kloof, 31,000 kg/yr, and Beatrix, nearly 19,000 kg/yr. At these rates of production, the life of the Kloof Mine was estimated to be 10 years; Driefontein, 8 years; and Beatrix, 5 years (Gold Fields Ltd., 2003, p. 11; 2004a, p. 13; 2004b, p. 13; 2005, p. 2, 13).

In 2004, gold production by Durban Roodepoort Deep Ltd. of South Africa declined to 23,170 kg from 26,465 kg in 2003. Output at the North West Mines declined to 9,993 kg from 11,820 kg, and at the Blyvooruitzicht Mine, to 5,866 kg from 7,672 kg. The decrease in production was attributable to mechanical problems and the reduction of unprofitable underground mining operations. In

the second quarter of 2004, cash operating costs at Blyvooruitzicht's underground operations were $488 per troy ounce of gold compared with $324 per troy ounce of gold in the same period in 2003. Production at the Crown and ERPM joint ventures increased to 7,311 kg in 2004 from 6,973 kg in 2003. The life of East Rand Proprietary Mines (ERPM) was expected to be 8 years (Durban Roodepoort Deep Ltd., 2003, 2004a, b; 2005).

Placer Dome Inc. produced gold at the South Deep Mine. In 2004, output was 6,665 kg from 1.1 Mt of ore milled compared with 6,854 kg from 979,000 t of ore milled in 2003. Cash costs increased to $394 per troy ounce of gold in 2004 from $301 per troy ounce of gold in 2003. Reserves amounted to 111 Mt at a grade of 7.8 g/t gold. Placer Dome planned to produce nearly 7,200 kg of gold at South Deep in 2005 (Placer Dome Inc., 2005, p. 21, 23, 36).

Thistle Mining Inc. of South Africa operated the President Steyn Mine in Free State. The company planned to produce 7,500 kg of gold in 2004 and to increase production to more than 9,300 kg by 2008. The increase would result from higher ore grades and an expansion of the ore treatment capacity. Production could increase eventually to 13,700 kg/yr after further increases in capacity. In 2003, reserves at President Steyn increased to 93,000 kg of contained gold from 47,000 kg in 2002 (Mining Review Africa, 2004b).

Anglo Platinum's production of refined gold from Rustenburg Base Metal Refiners declined to 3,418 kg in 2004 from 3,611 kg in 2003. Of this amount, 3,241 kg was attributable to Anglo Platinum's mining operations in 2004 compared with 3,571 kg in 2003; the remainder was attributable to purchased concentrates (Anglo American Platinum Corp., 2005, p. 86, 88).

The Rand Refinery in Germiston produced about 450,000 kg/yr of refined gold, which was 38% of the plant's capacity. About 290,000 kg/yr was attributable to domestic gold mines, and 10,000 kg/yr, to gold scrap from the jewelry industry. Roughly 150,000 kg/yr was attributable to imports, most of which were sourced from West Africa (Mining Review Africa, 2004c).

Iron Ore.—Assmang, Highveld Steel and Vanadium Corp. Ltd. of South Africa, and Kumba Resources Ltd. of South Africa mined iron ore. South Africa accounted for 3% of world iron ore production in 2004. National production of iron ore increased to 39.3 Mt in 2004 from 38.1 Mt in 2003. Iron ore exports amounted to $535 million in 2004 (Jorgenson, 2006, p. 40.25; Mining Journal, 2005).

Kumba Resources Ltd. operated the Sishen Mine in Northern Cape Province and the Thabazimbi Mine in Limpopo Province. The company's production of iron ore was 30.1 Mt in 2004, which was an increase of 1.8% compared with that of 2003. Output from the Sishen Mine amounted to 27.6 Mt; production was inhibited by the capacity of the Sishen/Saldanha railway (Kumba Resources Ltd., 2005, p. 33-34).

Kumba's exports of iron ore amounted to 20.9 Mt in 2004, which was an increase of 2.3% compared with that of 2003. The increase in the company's exports was partially attributable to the 10.8% increase in Chinese demand for steel in 2004. China accounted for 38% of Kumba's iron ore export revenues; Japan, 23%; the United Kingdom, 13%; Germany, 10%; and Austria, 9%. Kumba accounted for 4% of the world's seaborne iron ore trade (Kumba Resources Ltd., 2005, p. 2, 20, 34).

Mittal Steel South Africa Ltd. accounted for a majority of Kumba's domestic sales; the company had a contract with Kumba to purchase 6.25 Mt/yr of iron ore and the entire output of the Thabazimbi Mine. Kumba accounted for 81% of South Africa's total iron ore demand (Kumba Resources Ltd., 2005, p. 34).

In July 2004, Kumba completed a feasibility study on the expansion of the Sishen Mine. The expansion was likely to increase saleable iron ore production by 10 Mt/yr. Kumba planned to start production in mid-2007 and to reach full capacity by the beginning of 2009. The cost of the expansion was expected to be $461 million. Resources at Sishen were estimated to be 1.64 billion metric tons (Gt) at a grade of 64.9% iron (Kumba Resources Ltd., 2005, p. 43, 48).

Kumba also planned to develop the Sishen South project, which was located 70 km south of the Sishen Mine. Sishen South was expected to produce 9 Mt/yr of iron ore by 2010. The capital cost of the project was expected to be $342 million. The timing of the development of Sishen South depended on the availability of export routes through Coega or Saldanha. Resources at Sishen South were estimated to be 411 Mt at a grade of 64.5% iron (Kumba Resources Ltd., 2005, p. 43-44, 48).

Kumba was also conducting a feasibility study on the Phoenix project at the Thabazimbi Mine, which would produce 2 to 3 Mt/yr of iron ore and extend the life of the mine. The development of Thabazimbi depended on the negotiation of an agreement with Mittal. Resources at Thabazimbi were estimated to be 83 Mt at a grade of 62.7% iron (Kumba Resources Ltd., 2005, p. 44, 48).

Assmang produced iron ore at the Beeshoek Mine in Northern Cape. In financial year 2003-04, production at Beeshoek increased to 6.26 Mt from 5.81 Mt in financial year 2002-03. Resources at Beeshok amounted to 1.21 Gt at a grade of 64.6% iron, of which 462 Mt were reserves at a grade of 65.3% iron (Assmang Ltd., 2004a, p. 12; 2004b).

Assmang was engaged in exploration to increase its reserves at Beeshoek and was conducting a feasibility study on the development of the iron ore resources at the Bruce, the King, and the Mokaning properties. The feasibility study was expected to be completed in late 2005. If the feasibility study were to yield favorable results, the construction of a new mine was expected to be completed in 2008. The mine would have a capacity of 10 to 15 Mt/yr; Assmang's total iron ore production was expected to be more than 8 Mt in 2009, 10 Mt in 2011, and 14 Mt in 2012 (Assmang Ltd., 2004c; Motsepe, 2005, p. 27-28).

Highveld mined titaniferous magnetite at its Mapochs open pit mine near Roossenekal in the Mpumalanga Province. Mapochs had a capacity of 2.45 Mt/yr; average ore grades from the mine were 54.3% iron (Department of Minerals and Energy, 2004, p. 10).

Iron and Steel.—National production of crude steel was nearly unchanged in 2004 at 9.5 Mt. The production of pig iron declined to 6.01 Mt in 2004 from 6.23 Mt in 2003, and the production of direct-reduced iron (DRI) rose to 1.63 Mt from 1.54 Mt. South Africa's share of African pig iron output amounted to 74%; crude steel, 57%; and DRI, 26% (International Iron and Steel Institute, 2005, p. 3, 5, 11).

Iscor accounted for most of South Africa's production of crude steel at its Newcastle, Saldanha, Vanderbijlpark, and Vereeniging plants. In December 2004, Iscor's parent company merged with International Steel Group of the United States to form Mittal Steel Company N.V.

The production of liquid steel at Vanderbijlpark declined to 3.63 Mt in 2004 from 3.68 Mt in 2003 because of shutdowns for repairs. At Saldanha, production declined to 1.23 Mt in 2004 from 1.25 Mt in 2003 because of mechanical problems. At Newcastle and Vereeniging, production increased to 2.18 Mt from 2.15 Mt (Mittal Steel South Africa Ltd., 2005, p. 30-31, 35).

Mittal planned to increase liquid steel production at Vanderbijlpark by about 2 Mt/yr by the end of 2009. By the first half of 2006, Mittal expected to increase production by 325,000 t/yr with the installation of new DRI kilns. By the second half of 2006, the company planned to increase Vanderbijlpark's sinter plant capacity, increase production by 445,000 t/yr by relining blast furnace D, and gain an additional 660,000 t/yr from increased efficiency. By 2009, Mittal planned to increase production by an additional 355,000 t/yr by relining blast furnace C (Mittal Steel South Africa Ltd., 2005, p. 18).

Mittal's production of rolled steel products at Vanderbijlpark was about 3.4 Mt/yr; Newcastle and Vereeniging, nearly 2 Mt/yr; and Saldanha, about 1.3 Mt/yr. Vanderbijlpark produced a wide range of flat products that included steel slabs; plates; and hot-rolled, cold-rolled, galvanized, tin, and color-coated sheets. Saldanha produced mainly hot-rolled coil, and Newcastle and Vereeniging, long steel products. Mittal supplied about 80% of South Africa's demand for flat steel products; the company was Africa's leading flat steel producer (Mittal Steel South Africa Ltd., 2005, p. 28, 33).

Highveld operated a rolling mill at Witbank. In 2004, the company's production of rolled steel products was 674,013 t compared with 578,035 t in 2003 and 711,743 t in 2000. Scaw Metals (a subsidiary of Anglo American plc) increased production of rolled products at its Germiston plant to 458,000 t in 2004 from 352,000 t in 2003 (Anglo American plc, 2005, p. 118; Highveld Steel and Vanadium Corp. Ltd., 2005).

Columbus Stainless (Pty.) Ltd. operated South Africa's only stainless steel plant at Middleburg. Production amounted to 718,000 t in 2004 compared with 643,000 t in 2003 and 550,000 t in 2002. Columbus accounted for 3% of the world's stainless steel output in 2004 (Ferro-alloys Monthly, 2005).

Lead and Zinc.—South Africa's mine production of zinc declined to 32,310 t in 2004 from 41,400 t in 2003. The decrease in production was partially attributable to the shutdown of the Maranda copper-zinc mine in the third quarter of 2004 (Metorex Ltd., 2004). Lead mine production declined to 37,485 t in 2004 from 39,941 t in 2003.

Anglo American plc operated the Black Mountain lead-zinc-copper mine near Aggeneys in Northern Cape Province. In 2004, production at Black Mountain amounted to 28,200 t of zinc and 37,500 t of lead from 1.5 Mt of ore milled compared with 25,900 t of zinc and 39,600 t of lead from 1.45 Mt of ore milled in 2003. The development of the Deeps Mine at Black Mountain was likely to continue in 2005; zinc production was expected to increase. The final cost of the expansion at Black Mountain was expected to be $125 million (Anglo American plc, 2005, p. 10, 117).

Zinc Corp. of South Africa Ltd. (a subsidiary of Kumba Resources Ltd.) operated South Africa's only zinc refinery at Springs. In 2004, production declined to 104,000 t from 113,000 t because of shortages of concentrates created by lower domestic zinc mine production (Kumba Resources Ltd., 2005, p. 40).

Manganese.—About four-fifths of the world's manganese ore reserve base was located in South Africa. In 2004, South Africa's mine production of manganese ore increased to nearly 4.21 Mt from 3.5 Mt in 2003. Manganese ore exports amounted to $168 million in 2004 (Mining Journal, 2005).

Samancor operated the Mamatwan open pit mine and the Wessels underground mine near Hotazel in Northern Cape Province; these mines had a combined capacity of 3.4 Mt/yr. In 2004, Samancor's production of manganese ore increased to 2.52 Mt from 2.36 Mt. Reserves at Wessels were estimated to be 22 Mt at a grade of 37.5% manganese, and at Mamatwan, 9.9 Mt at a grade of 48% manganese (BHP Billiton Group, 2004, p. 3; 2005, p. 3; Mining Journal, 2005).

Assmang produced manganese ore at the Gloria and the Nchwaning Mines. In financial year 2003-04, production at the mines increased to 1.41 Mt from 1.37 Mt in financial year 2002-03. Resources at the mines were 631 Mt at a grade of 39.4% manganese, of which 131 Mt was reserves at a grade of 44.1% manganese. Ore grades at the Nchwaning Mine ranged from 43.3% to 46.3% manganese; and at the Gloria Mine, from 34.2% to 38.6% manganese. Resources increased to 631 Mt in 2004 from 156 Mt in 2003, and reserves, to 131 Mt from 119 Mt (Assmang Ltd., 2004a, p. 12; 2004b; Mining Journal, 2005).

In 2004, Assmang completed the sinking of the Number 3 Shaft at Nchwaning that increased the company's production capacity to 3.5 Mt/yr of manganese ore. Assmang planned to increase its production to nearly 2 Mt in 2005 and to more than 2.5 Mt by 2010. The capital cost of the expansion at Nchwaning was estimated to be $116 million (Assmang Ltd., 2004b; Motsepe, 2005, p. 29-30).

South Africa was the world's second ranked producer of ferromanganese in 2003. Samancor produced ferromanganese and silicomanganese at its plant at Meyerton. The company's production of manganese alloys was 504,000 t in 2004 compared with 469,000 t in 2003. Assmang produced ferromanganese and silicomanganese at the Cato Ridge plant in Kwa-Zulu Natal. In financial year 2003-04, production at Cato Ridge increased to 238,000 t from 229,000 t in financial year 2002-03. Highveld's production of silicomanganese was 137,606 t, which was nearly unchanged from that of 2003 (Assmang Ltd., 2004b; BHP Billiton Group, 2004, p. 3; 2005, p. 3; Highveld Steel and Vanadium Corp. Ltd., 2005).

Nickel.—Most of South Africa's nickel mine production was a coproduct of PGM mining. In 2004, national nickel mine production declined to 39,853 t from 40,842 t in 2003. Domestic nickel consumption amounted to about 25,000 t in 2004.

Anglo Platinum increased its production of refined nickel at Rustenburg Base Metal Refiners to 22,300 t in 2004 from 22,100 t in 2003 and 19,200 t in 2000. About 21,200 t was attributable to Anglo Platinum's mining operations compared with 21,900 t in 2003 and 10,800 t in 2000 (Anglo American Platinum Corp., 2005, p. 86, 88).

In financial year 2003-04, Impala Platinum Holdings Ltd. (Implats) produced 9,500 t of refined nickel from its refinery northeast of Johannesburg compared with 6,700 t in financial year 2002-03. Production at this plant was from purchased concentrates and toll refining. Implats also produced nickel from its Impala PGM mines near Rustenburg in the North West Province; production of refined nickel from Impala declined to 6,900 t in financial year 2003-04 from 8,000 t in financial year 2002-03. Implats produced small amounts of nickel from the Marula PGM mine (Impala Platinum Holdings Ltd., 2004, p. 51, 54, 63).

African Rainbow Minerals Ltd. of South Africa operated the Nkomati nickel mine, which was South Africa's only primary nickel producer. Production at Nkomati was about 5,000 t/yr of nickel. The company planned to increase production to 16,000 t/yr of nickel. Resources at Nkomati were estimated to be 143 Mt at a grade of 0.47% nickel, of which 65 Mt was reserves at a grade of 0.5% nickel. The life of the mine was expected to be 15 years (Motsepe, 2005, p. 24-25).

Platinum-Group Metals.—South Africa was the world's leading producer of PGM in 2004. The country's share of world platinum production was 75%; palladium, 42%; and other PGM, 75%. South Africa's production of PGM increased to 286,156 kg in 2004 from 266,150 kg in 2003. In 2004, national exports of platinum amounted to $3.66 billion; palladium, $502 million; rhodium, $356 million; and ruthenium, $47.7 million (Mining Journal, 2005; George, 2006).

In 2004, Anglo Platinum produced 137,700 kg of refined PGM compared with 129,400 kg in 2003. About 130,100 kg was attributable to the company's mining operations in 2004 compared with 126,200 kg in 2003. Platinum produced from Anglo's mining operations amounted to 72,400 kg; palladium, 38,200 kg; and rhodium, nearly 7,500 kg (Anglo American Platinum Corp., 2005, p. 86, 88).

At the Rustenburg Section, platinum production increased to 26,900 kg in 2004 from 25,700 kg in 2003 because of higher output from the UG2 project. Anglo Platinum planned to increase platinum output at Rustenburg to between 28,000 kg/yr and 31,100 kg/yr. Production at the Amandelbult Section declined to 18,400 kg of platinum from 20,100 kg because of difficult geologic conditions and labor disputes. Output was expected to increase in 2005. At the Bafokeng-Raismone Platinum Mine, platinum output was expected to rise to more than 6,200 kg in 2005 from nearly 5,800 kg in 2004. The Western Limb Tailings Retreatment project produced nearly 2,100 kg of platinum in its first year of operation. Production at the Lebowa Platinum, the Potgietersrust Platinums, and the Union Mines was likely to remain unchanged (Anglo American Platinum Corp., 2005, p. 16-17, 42-48, 86, 88).

At the Modikwa Mine (a joint venture with African Rainbow Minerals), production of PGM rose to 8,603 kg in 2004 from 6,373 kg in 2003; platinum production rose to 3,546 kg from 2,681 kg in 2003. Increased production was attributable to a higher ore grade. By mid-2005, Modikwa was expected to reach its full planned production of 11,400 kg/yr of PGM, which included 5,000 kg/yr of platinum (Anglo American Platinum Corp., 2005, p. 98; Motsepe, 2005, p. 19).

In 2004, production at the Kroondal Mine (a joint venture with Aquarius Platinum Ltd. of South Africa) increased to 8,014 kg of PGM from 6,729 kg in 2003; platinum production increased to 4,823 kg from 4,132 kg. Higher production was attributable to an increase in the amount of ore milled. In the first quarter of 2005, Anglo Platinum and Aquarius planned to commission a new concentrator at Kroondal that was expected to increase Kroondal's production to 15,700 kg/yr of PGM (Aquarius Platinum Ltd., 2004, p. 3-7; 2005, p. 3-7).

Anglo Platinum planned to increase its total platinum production to about 105,000 kg in 2006. In December 2003, the company announced that it was scaling back its planned production to between 84,000 kg and 87,000 kg of platinum in 2006 because of the strength of the South African rand (Anglo American Platinum Corp., 2005, p. 17-18).

Implats operated the Impala Mines near Rustenburg in North West Province and the Marula Mine in Limpopo Province. In financial year 2003-04, production of refined PGM at Impala was 61,445 kg compared with 59,828 kg in financial year 2002-03. Implats planned to maintain production at between 59,000 kg/yr and 62,000 kg/yr of PGM, which included between 31,000 kg/yr and 34,000 kg/yr of platinum, for the 30-year life of the mines (Impala Platinum Holdings Ltd., 2004, p. 45-51).

In financial year 2003-04, platinum production at Marula amounted to 414 kg; palladium, 411 kg; and rhodium, 84 kg. Production was inhibited by difficult geologic conditions. Implats planned to increase platinum production at Marula to 3,100 kg in financial year 2006-07 and 3,900 kg in financial year 2008-09. The life of the mine was expected to be 25 years (Impala Platinum Holdings Ltd., 2004, p. 52-54).

Implats also operated a refinery northeast of Johannesburg; production at this plant was from purchased concentrates and toll refining. In financial year 2003-04, the refinery's production increased to 54,409 kg of PGM from 38,506 kg in financial year 2002-03. Implats planned to increase production to 62,000 kg of PGM in financial year 2006-07 and to more than 71,000 kg in financial year 2008-09 (Impala Platinum Holdings Ltd., 2004, p. 62-63).

African Rainbow Minerals and Implats were engaged in a joint venture to develop the Two Rivers Mine in Mpumalanga Province. The companies planned to produce nearly 7,200 kg/yr of PGM, which included 3,400 kg/yr of platinum. Production was expected to start in 2005; the mine was expected to reach its full capacity in 2008. Capital costs of the project were likely to be nearly $190 million. Resources at Two Rivers were estimated to be 117 Mt at a grade of 3.9 g/t PGM and gold. African Rainbow Minerals also planned to produce 3,100 kg/yr of PGM with the expansion of the Nkomati nickel mine (Motsepe, 2005, p. 20-21, 24-25).

Lonmin plc of the United Kingdom mined PGM at the Western Platinum Mine, the Eastern Platinum Mine, and the Karee Mine east of Rustenburg in the North West Province. From September 2003 to September 2004, Lonmin produced 28,514 kg of platinum compared with 26,558 kg in the previous 12 months. Total production of PGM increased to 52,147 kg from 50,760 kg. Ore processed declined to 11.1 Mt from 11.4 Mt (Lonmin plc, 2005§).

Aquarius operated the Marikana Mines. In 2004, production of PGM at Marikana was 2,583 kg compared with 2,315 kg in 2003; platinum production rose to 1,720 kg from 1,573 kg. Higher production was attributable to increases in ore processed. In October 2004, Aquarius started construction on the Everest Mine, which was expected to be completed in December 2005. The company planned to reach full production of 7,000 kg/yr of PGM in 2006. Capital costs were expected to be $127 million. Reserves at Everest were estimated to be 26.8 Mt at a grade of 3.36 g/t PGM (Aquarius Platinum Ltd., 2004, p. 3-7; 2005, p. 3-8).

Silicon.—In 2004, Silicon Smelters (Pty.) Ltd. was the only domestic producer of silicon metal; the company increased its production to 50,500 t from 48,500 t in 2003. South Africa accounted for about 5% of world silicon metal production. National ferrosilicon production rose to 140,600 t in 2004 from 135,300 t in 2003. In 2004, Highveld produced 58,155 t of ferrosilicon compared with 55,453 t in 2003 from its plant at Witbank. Silicon Technology (Pty.) Ltd. also produced ferrosilicon (Bonga, 2005; Highveld Steel and Vanadium Corp. Ltd., 2005).

Silver.—National silver mine production was 71,600 kg in 2004 compared with 79,817 kg in 2003 and 144,143 kg in 2000. Silver was mined as a coproduct of copper, gold, lead, PGM, nickel, and zinc. In 2004, lead-zinc mines accounted for 55% of South Africa's silver production; gold mines, 32%; copper mines, 11%; and nickel and PGM mines, 2%. The Rand Refinery produced about 80,000 kg/yr of refined silver (Damarupurshad, 2005a; Mining Review Africa, 2004c; Mining Journal, 2005).

Titanium and Zirconium.—BHP Billiton Group and Rio Tinto plc mined ilmenite, rutile, and zircon, and produced titania slag at Richards Bay. In financial year 2003-04, the production of titania slag at Richards Bay declined by 12.5% because of oversupply in world markets.

In 2004, Kumba and its joint-venture partner Ticor Ltd. of Australia produced 459,000 t of ilmenite from the Hillendale Mine in KwaZulu Natal Province; production was unchanged from that of 2003. Rutile production increased by 18% to 20,000 t, and zircon production declined by 2% to 49,000 t. Kumba and Ticor planned to start production at the Fairbreeze Mine south of Hillendale in 2007. Resources at Fairbreeze were estimated to be 223 Mt at a grade of 3.6% ilmenite, and at Hillendale, 56 Mt at a grade of 3.7% ilmenite (Kumba Resources Ltd., 2005, p. 38, 45, 48).

Kumba and Ticor also operated the Empangeni smelter near the Hillendale Mine. In 2004, production of titania slag nearly tripled to 136,000 t; the companies planned to increase output to 250,000 t/yr (Kumba Resources Ltd., 2005, p. 2, 38).

Vanadium.—Highveld, Vametco Minerals Corp., and Xstrata mined vanadium from vanadiferous magnetite. South Africa was the world's leading producer of vanadium and accounted for 31% of global vanadium reserves in 2003. Although most of South Africa's vanadium production was exported, domestic consumption increased substantially in 2004 because of growth in the construction sector and rising demand for chemical applications (Kweyama, 2005).

Highveld produced vanadium from titaniferous magnetite ore at the Mapochs Mine. In 2004, the company produced 8,448 t of vanadium from 67,587 t of vanadium slag compared with 8,232 t of vanadium from 69,814 t of vanadium slag in 2003. Highveld also produced 5,258 t of vanadium in chemicals, ferrovanadium, and vanadium pentoxide (V_2O_5) in 2004 compared with 5,237 t in 2003 (Anglo American plc, 2005, p. 118; Highveld Steel and Vanadium Corp. Ltd., 2005).

Xstrata produced V_2O_5 at Rhovan and Vantech in Brits; the plants had a combined capacity of 16,600 t/yr of V_2O_5. In November 2004, Xstrata announced the permanent closure of the Vantech operation. Vantech was placed on care and maintenance in early 2004 after the Kennedy Vale deposit was depleted in December 2003. Xstrata's decision was influenced by the cost of developing the Steelpoortdrift deposit, the strength of the South African rand, and concerns about the sustainability of high vanadium prices. Production at Vantech was 548 t of V_2O_5 in 2004 compared with 4,632 t in 2003. At Rhovan, production increased to 9,035 t of V_2O_5 compared with 8,255 t in 2003. Xstrata also produced ferrovanadium at Rhovan; production declined to 5,910 t in 2004 from 6,306 t in 2003 (Ryan's Notes, 2004; Xstrata plc, 2005, p. 46, 176).

Industrial Minerals

Diamond.—South Africa was the world's fifth ranked diamond producer by volume, accounting for about 9% of world production. In 2004, national rough diamond production rose to about 14.3 million carats from 12.7 million carats in 2003. Kimberlites accounted for 13 million carats; alluvial deposits, 1.21 million carats; and marine deposits, 81,000 carats. The value of diamond that was cut and polished in South Africa amounted to about $500 million in 2004 (Northwest Territories Department of Industry, Tourism and Investment, 2005, p. 6, 9).

DeBeers Group accounted for most of South Africa's rough diamond production. In 2004, the company's production of diamond was more than 13.7 million carats from 33.8 Mt of ore milled compared with 11.9 million carats from 28.7 Mt of ore milled in 2003. Ore grades varied from 5.8 carats per 100 metric tons at the Koffiefontein Mine to 122 carats per 100 metric tons at the Venetia Mine (DeBeers Group, 2005, p. 50).

The production increase in 2004 was mostly attributable to the Kimberley and Venetia Mines. At Kimberley, production was 2.05 million carats from 9.07 Mt of ore milled in 2004 compared with 1.05 million carats from 5.96 Mt of ore milled in 2003; new retreatment technology was the most important factor in the increase. At Venetia, production was 7.19 million carats from 5.87 Mt of ore milled in 2004 compared with 6.6 million carats from 5.41 Mt of ore milled in 2003. In 2004, the Finsch Mine produced nearly 2.11 million carats; the Cullinan Mine, 1.3 million carats; the Namaqualand Mine, 909,706 carats; the Koffiefontein Mine, 113,481 carats; and The Oaks Mine, 68,943 carats (DeBeers Group, 2005, p. 42).

Trans Hex Group of South Africa operated the Baken, the Bloeddrif, the Reuning, and the Saxendrift Mines. In financial year 2003-04, the Baken Mine produced 88,100 carats; the Saxendrift Mine, 22,200 carats; the Bloedorf Mine, 14,500 carats; and the Reuning Mine, 13,700 carats (Trans Hex Group, 2005, p. 12-13).

SouthernEra Diamonds Inc. of Canada had a joint-venture agreement with Naka Diamond Mining Company for the Klipspringer Mine in Limpopo Province. The Klipspringer Mine had a capacity of 151,000 carats per year and an estimated life of 10 years. Resources were estimated to be 4.5 Mt at a grade of 46.5 carats per 100 metric tons. In December 2003, the mine was placed on care and maintenance because of the strength of the South African rand. Naka and SouthernEra were considering the treatment of stockpiles at Marsfontein. SouthernEra was awarded the Hope and the Prieska prospecting permits in April 2004; the company and its joint-venture partners planned to explore Harmony, Hope, and Prieska in 2005 (SouthernEra Diamonds Inc., 2005, p. 6-8, 14, 15).

Fluorspar.—Van den Heever Fluorspar Works, Vergenoeg Mining Corp. (Pty.) Ltd., and Witkop Fluorspar Mine (Pty.) Ltd. produced fluorspar. In 2004, national production of fluorspar rose to 265,000 t from 235,000 t in 2003. The increase was attributable to upgrades at the Vergenoeg Mine in December 2003 and the Witkop Mine in September 2004; the expansion at Witkop increased production to 180,000 t/yr. Additionally, the reduction in Chinese export quotas led to a shortage of fluorspar in the world market. South Africa's exports amounted to 233,000 t at a value of $28.5 million in 2004; domestic consumers of fluorspar included the cement and steel industries (Naledi, 2005).

Vermiculite.—South Africa was the world's leading producer of vermiculite; it accounted for nearly 40% of world production in 2004. National vermiculite production rose by 7.7% in 2004. The Palabora Mine accounted for most of South Africa's production of vermiculite. In 2004, production at Palabora increased to 193,400 t from 173,200 t in 2003 (Rio Tinto plc, 2005, p. 19; Willett and Potter, 2006).

Mineral Fuels

Coal.—In 2004, South Africa's production of coal increased to 242.7 Mt from 239.3 Mt in 2003. More than 99% of the country's coal output was bituminous coal. South Africa was Africa's leading producer of coal, accounting for 98% of continental production in 2004. In 2004, exports of coal amounted to $2.21 billion (Mining Journal, 2005).

Ingwe Coal Corp. Ltd. (a subsidiary of BHP Billiton Group) produced coal at the Douglas, the Khutala, the Klipspruit, the Koornfontein, the Middleburg, and the Rietspruit Mines in Mpumalanga Province. In 2004, Ingwe produced 55.3 Mt of coal compared with 54.3 Mt in 2003. The company had a joint-venture agreement with Xstrata for the Douglas and the Middleburg Mines, where production declined to 23.9 Mt in 2004 from 24.4 Mt in 2003. Sales to local utilities amounted to 32.7 Mt in 2004; exports, 20.5 Mt; and other South African customers, 1.4 Mt (BHP Billiton Group, 2004, p. 13; 2005, p. 12).

Anglo American increased its production of coal to nearly 54.5 Mt in 2004 from 51.7 Mt in 2003. The increase in output was broadly based, with production at New Vaal rising to 17.3 Mt from 16 Mt; at Goedehoop, to 6.46 Mt from 5.96 Mt; at New Denmark, to 4.98 Mt from 4.32 Mt; and at Kleinkopje, to 4.69 Mt from 4.38 Mt. Output also rose slightly in 2004 at the Kriel, the Greenside, and the Nooitgedacht Mines, which produced 11.1 Mt, 2.75 Mt, and 677,000 t, respectively. The Mafube Mine, which opened in 2004, produced 321,000 t. Higher production at these mines was attributable to increased demand from South African utility Eskom. Anglo planned to acquire new equipment to increase production at New Demark in 2005. In 2004, production at the Bank Mine declined to 2.73 Mt from 3.23 Mt in 2003 because of difficult mining conditions (Anglo American plc, 2005, p. 11, 114).

In financial year 2003-04, Sasol Ltd. of South Africa increased its coal production to 52.4 Mt from 51.3 Mt in financial year 2002-03. At the Secunda Mining Complex, which included the Bossjesspruit, the Brandspruit, the Middelbult, the Syferfontein, and the Twistdraai Mines, output rose to 46.2 Mt from 45.4 Mt. At the Sigma Mine, production increased to 6.2 Mt from 5.9 Mt. Sasol consumed 47 Mt of coal in the production of synthetic fuels and other chemicals and exported 3.6 Mt in financial year 2003-04 (Sasol Ltd., 2004, p. 31-32).

Sasol was engaged in a joint-venture agreement with Anglo American to develop the Kriel South coal reserves and to expand the Syferfontein Mine. Each of these projects was expected to increase coal production by 5 Mt/yr starting in July 2005. Anglo American planned to sell the output of Kriel South to Sasol for synthetic fuel production. The project was expected to cost $169 million. Sasol's coal reserves amounted to 1.55 Gt in 2004, which included 155 Mt at Syferfontein and South Kriel, 142 Mt at Bossjesspruit, and 137 Mt at Middlebult (Sasol Ltd., 2004, p. 32, 88).

Eyesizwe Coal (Pty.) Ltd. of South Africa produced 25 Mt/yr of coal from the Arnot, the Glisa, the Matla, the Mafube, and the New Clydesdale Mines. The company exported about 1.2 Mt/yr of coal; Europe accounted for 90% of Eyesizwe's exports, and South America, 10%. In late 2004, Eyesizwe and Anglo American started production at the Mafube Mine in Mpumalanga Province, which produced at a rate of 1.2 Mt/yr. The companies planned to finish a feasibility study to increase production at Mafube by between 4 and 5 Mt/yr in 2005. If the study were to yield favorable results, production could start in 2007. Kumba and Eyesizwe were engaged in a joint venture to build the Inyanda Coal Mine near Witbank with a capacity of 1 Mt/yr (Kumba Resources Ltd., 2005, p. 45; Reuters, 2005).

Kumba operated the Grootegeluk and the Tshikandeni Mines in Limpopo Province and the Leeuwpan Mine in Mpumalanga Province. The company's production amounted to more than 19.4 Mt in 2004, which was an increase of 2.5% from that of 2003. Output increased at the Grootegeluk Mine, which produced 17.4 Mt of coal in 2004. At the Tshikandeni Mine, production increased by 15% in 2004. Sales to Eskom amounted to nearly 14 Mt; other domestic consumers, 4.1 Mt; and exports, 1.1 Mt (Kumba Resources Ltd., 2005, p. 36).

Kumba planned to increase its production to 21.7 Mt/yr with expansions that included 1 Mt/yr of new capacity at the Leeuwpan Mine and 530,000 t/yr at the Grootegeluk Mine. These projects were approved in August 2004; the expansions at Leeuwpan and Grootegeluk were expected to be complete in August 2005 and July 2006, respectively. By March 2005, Kumba also expected to complete a prefeasibility study on the Waterburg development, which could increase production at the Grootegeluk Mine by an additional 6 Mt/yr. If the study yielded favorable results, the company planned to complete a feasibility study by March 2006. Production from the expanded mine could start by early 2008 (Kumba Resources Ltd., 2005, p. 44-45).

Xstrata operated 11 coal mines at Breyten, Carolina, Ermelo, and Witbank. In 2004, the company's coal production increased to 16.9 Mt from 14.9 Mt in 2003. Production at the Tavistock Mine rose to 1.88 Mt from 1.42 Mt because of upgrades to the beneficiation plant and mining equipment in 2003 and 2004. At the South Witbank Mine, output rose to 1.77 Mt from 1.46 Mt because of greater efficiencies in the production process. Production at the Goedgevonden Mine increased to 1.1 Mt from 163,000 t; Xstrata planned to increase output to 1.5 Mt/yr by 2008. At the Phoenix Mine, production rose to 1.66 Mt from 846,000 t. Output declined from 1.26 Mt to 920,000 t at the Spitzkop Mine and from nearly 1.13 Mt to 814,000 t at the Waterpan Mine (Xstrata plc, 2005, p. 47-48, 179; undated§).

Petroleum.—South Africa produced modest amounts of crude petroleum; most of the country's output of refined petroleum products was derived from imports. In 2004, South Africa's consumption of petroleum products amounted to 525 million barrels (Mbbl) compared with 513 Mbbl in 2003 and 462 Mbbl in 2000. South Africa accounted for 20% of African petroleum products consumption and nearly 1% of world petroleum products consumption (British Petroleum plc, 2005, p. 9).

Uranium.—Anglogold Ashanti mined uranium as a coproduct of gold at its Vaal Reefs operations. In 2004, the production of uranium oxide declined to 887 t from 894 t in 2003 and 1,015 t in 2000. The company planned to increase production because of higher uranium prices. South Africa's entire production of uranium was exported in 2004 (Damarupurshad, 2005a).

Outlook

Capacity expansions by numerous producers were likely to lead to higher production of coal, ferrochromium, fluorspar, iron ore, manganese, nickel, PGM, and steel for the next 5 years. These expansions depended upon the continuation of the broad-based increase in world demand for minerals. Factors that could inhibit these plans included the strength of the South African rand and the high rates of HIV infection in the mining workforce.

References

Amey, E.B., 2006, Gold: U.S. Geological Survey Mineral Commodity Summaries 2006, p. 74-75.
Anglo American Platinum Corp., 2005, Business report 2004: Johannesburg, South Africa, Anglo American Platinum Corp., 196 p.
Anglo American plc, 2005, Annual report 2004: London, United Kingdom, Anglo American plc, 124 p.
AngloGold Ashanti Ltd., 2005, Annual report 2004: Johannesburg, South Africa, AngloGold Ashanti Ltd., 188 p.
Aquarius Platinum Ltd., 2004, Quarterly report 31 December 2003: Bedfordview, South Africa, Aquarius Platinum Ltd., 20 p.
Aquarius Platinum Ltd., 2005, Quarterly report 31 December 2004: Bedfordview, South Africa, Aquarius Platinum Ltd., 20 p.
Assmang Ltd., 2004a, Annual report 2004: Johannesburg, South Africa, Assmang Ltd., 54 p.
Assmang Ltd., 2004b, Financial results for the year ended 30 June 2004: Johannesburg, South Africa, Assmang Ltd., 1 p.
Assmang Ltd., 2004c, Financial results for the year ended 31 December 2004: Johannesburg, South Africa, Assmang Ltd., 1 p.
BHP Billiton Group, 2004, BHP Billiton production report for the quarter ended 31 December 2003: Melbourne, Australia, BHP Billiton Group press release, January 29, 18 p.
BHP Billiton Group, 2005, BHP Billiton production report for the quarter ended 31 December 2004: Melbourne, Australia, BHP Billiton Group press release, January 27, 15 p.
Bonga, Mpumzi, 2005, Silicon, *in* South Africa's mineral industry 2004/2005: Johannesburg, South Africa, Department of Minerals and Energy, p. 115-117.
British Petroleum plc, 2005, Statistical review of world energy June 2005: London, United Kingdom, British Petroleum plc, 41 p.
Damarupurshad, Ashok, 2005a, Silver, *in* South Africa's mineral industry 2004/2005: Johannesburg, South Africa, Department of Minerals and Energy, p. 38-42.
Damarupurshad, Ashok, 2005b, Uranium, *in* South Africa's mineral industry 2004/2005: Johannesburg, South Africa, Department of Minerals and Energy, p. 54-58.
DeBeers Group, 2005 Annual review 2004: Johannesburg, South Africa, DeBeers Group, 64 p.
Department of Minerals and Energy, 2004, Ferrous mineral commodities produced in the Republic of South Africa 2004: Johannesburg, South Africa, Department of Minerals and Energy, 35 p.
Durban Roodepoort Deep Ltd., 2003, Report to shareholders for the 4th quarter and year ended 30 June 2003: Parktown, South Africa, Durban Roodepoort Deep Ltd., 6 p.
Durban Roodepoort Deep Ltd., 2004a, Report to shareholders for the 2nd quarter ended 31 December 2003 of the 2004 financial year: Parktown, South Africa, Durban Roodepoort Deep Ltd., 6 p.
Durban Roodepoort Deep Ltd., 2004b, Report to shareholders for the 4th quarter ended 30 June 2004 of the 2004 financial year: Parktown, South Africa, Durban Roodepoort Deep Ltd., 6 p.
Durban Roodepoort Deep Ltd., 2005, Report on activities for the second quarter ended 31 December 2004 of the 2005 financial year: Parktown, South Africa, Durban Roodepoort Deep Ltd., 9 p.
Ferro-alloys Monthly, 2005, World alloy steels production: Ferro-alloys Monthly, no. 158, October, p. 10.
George, M.W., 2006, Platinum group metals, *in* Metals and minerals: U.S. Geological Survey Minerals Yearbook 2004, v. I, p. 57.1-57.12.
Gold Fields Ltd., 2003, Quarter and year ended results to 30 June 2003: Johannesburg, South Africa, Gold Fields Ltd., 18 p.
Gold Fields Ltd., 2004a, Quarter ended 31 December 2003: Johannesburg, South Africa, Gold Fields Ltd., 18 p.
Gold Fields Ltd., 2004b, Results for the quarter and year ended 30 June 2004: Johannesburg, South Africa, Gold Fields Ltd., 18 p.
Gold Fields Ltd., 2005, Quarter ended 31 December 2004: Johannesburg, South Africa, Gold Fields Ltd., 18 p.
Harmony Gold Mining Company Ltd., 2003, Review for the quarter and financial year ended 30 June 2003: Melrose Arch, South Africa, Harmony Gold Mining Company Ltd., 36 p.
Harmony Gold Mining Company Ltd., 2004a, Review for the quarter ended 31 December 2003: Melrose Arch, South Africa, Harmony Gold Mining Company Ltd., 36 p.
Harmony Gold Mining Company Ltd., 2004b, Review for the quarter ended 30 June 2004: Melrose Arch, South Africa, Harmony Gold Mining Company Ltd., 52 p.
Harmony Gold Mining Company Ltd., 2005, Review for the quarter ended 31 December 2004: Melrose Arch, South Africa, Harmony Gold Mining Company Ltd., 56 p.
Highveld Steel and Vanadium Corp. Ltd., 2005, Results for the year ended 31 December 2004: Witbank, South Africa, Highveld Steel and Vanadium Corp. Ltd., unpaginated.
Impala Platinum Holdings Ltd., 2004, Annual report 2004: Marshalltown, South Africa, Impala Platinum Holdings Ltd., 153 p.
International Iron and Steel Institute, 2005, Steel statistical yearbook 2005: Brussels, Belgium, International Iron and Steel Institute, 104 p.
International Monetary Fund, 2005, World economic outlook—Building institutions: Washington, DC, International Monetary Fund, September, 293 p.
Jorgenson, J.D., 2006, Iron ore, *in* Metals and minerals: U.S. Geological Survey Minerals Yearbook 2004, v. I, p. 40.1-40.28.
Kumba Resources Ltd., 2005, Annual report 2004: Pretoria, South Africa, Kumba Resources Ltd., 182 p.
Kweyama, N., 2005, Vanadium, *in* South Africa's mineral industry 2004/2005: Johannesburg, South Africa, Department of Minerals and Energy, p. 118-120.
Metorex Ltd., 2004, Update on Ruashi project: Johannesburg, South Africa, Metorex Ltd. press release, October 8, 5 p.
Mining Journal, 2005, South Africa—Political and economic challenges: Mining Journal, July 15, p. 18-22.
Mining Review Africa, 2004a, Avgold deal consolidates Harmony further in the Free State: Mining Review Africa, no. 2, p. 50-53.
Mining Review Africa, 2004b, Plans to expand production at President Steyn: Mining Review Africa, no. 2, p. 44-48.
Mining Review Africa, 2004c, Rand refinery looks for competitive advantage: Mining Review Africa, no. 6, p. 12-15.
Mittal Steel South Africa Ltd., 2005, Annual report 2004: Vanderbijlpark, South Africa, Mittal Steel South Africa Ltd., 186 p.
Motsepe, Patrice, 2005, African Rainbow Minerals Ltd.—Presentation at Indaba 2005: Africa Mining Investment Conference, Cape Town, South Africa, February 8-10, 2005, 35 p.
Mwape, P., Roberts, M.J., Mokwena, E., Tjatjie, T., and Phale, M., 2005, General review, *in* South Africa's mineral industry 2004/2005: Johannesburg, South Africa, Department of Minerals and Energy, p. 1-23.
Naledi, Olga, 2005, Fluorspar production and developments during 2004/05: MB Bulletin, v. 18, no. 2, July, p. 5-6.

Northwest Territories Department of Industry, Tourism and Investment, 2005, 2005 Diamond industry report—Diamond facts: Yellowknife, Northwest Territories, Canada, Northwest Territories Department of Industry, Tourism and Investment, 36 p.
Papp, J.F., 2006, Chromium, *in* Metals and minerals: U.S. Geological Survey Minerals Yearbook 2004, v. I, p. 17.1-17.25.
Placer Dome Inc., 2005, Annual report 2004: Vancouver, British Columbia, Canada, Placer Dome Inc., 92 p.
Potter, M.J., 2006, Kyanite and related materials: U.S. Geological Survey Mineral Commodity Summaries 2006, p. 94-95.
Reuters, 2005, Eyesizwe plans more coal output, exports: Reuters press release, April 14, 2 p.
Rio Tinto plc, 2005, Fourth quarter 2004 operations review: London, United Kingdom, Rio Tinto plc, 23 p.
Ryan's Notes, 2004, Xstrata to permanently shut Vantech: Ryan's Notes, v. 10, no. 45, November 8, p. 1.
Sasol Ltd., 2004, Form 20-F 2004: Rosebank, South Africa, Sasol Ltd., 311 p.
SouthernEra Diamonds Inc., 2005, Annual report 2004: Toronto, Ontario, Canada, SouthernEra Diamonds Inc., 16 p.
Trans Hex Group, 2005, Annual report 2005: Cape Town, South Africa, Trans Hex Group, 78 p.
Willett, J.C., and Potter, M.J., 2006, Vermiculite, *in* Metals and minerals: U.S. Geological Survey Minerals Yearbook 2004, v. I, p. 81.1-81.7.
Xstrata plc, 2005, Annual report 2004: Zug, Switzerland, Xstrata plc, 180 p.

Internet References

International Monetary Fund, 2005 (September), South Africa, World Economic Outlook Database, accessed December 16, 2005, via URL http://www.imf.org/external/pubs/ft/weo/2005/02/data/index.htm.
Lonmin plc, 2005, 5 Year Operating Statistics, accessed December 30, 2005, at URL http://www.lonmin.com/OurBusiness/Platinum/5YearOperatingStatistics/tabid/105/Default.aspx.
Samancor Ltd., [undated], Samancor—Operations and locations—Overview, accessed December 27, 2005, at URL http://www.samancorcr.com/content.asp?submID=13.
Xstrata plc, undated, Coal, accessed December 29, 2005, at URL http://www.xstrata.com/prod_coal.php.

TABLE 1
SOUTH AFRICA: PRODUCTION OF MINERAL COMMODITIES[1]

(Metric tons unless otherwise specified)

Commodity		2000	2001	2002	2003	2004[p]
METALS						
Aluminum metal, primary		673,486	662,497	706,916	738,000 [r]	863,000
Antimony concentrate:						
Gross weight		6,400	8,320	9,910	9,000	8,400 [e]
Sb content (58% Sb)		3,710	4,827 [r]	5,746	5,291 [r]	4,967
Chromiun, gross weight:						
44% to 48% chromic oxide	thousand metric tons	2,261	2,180	2,459	2,640	2,888
Less than 44% chromic oxide	do.	4,360	3,322	3,977	4,766	4,789
Total	do.	6,621	5,502	6,436	7,406	7,677
Cobalt:						
Mine output, Co content[e]		580	550	540	404	280
Refinery output:		397	371	366	271	309
Copper:						
Mine (company output), Cu content		137,092	141,865	129,589	120,800 [r]	102,577
Metal:						
Smelter		172,800	142,500	119,667	112,025	89,300
Refined, primary		126,100	132,078	101,000	111,000 [r]	91,498
Gold, primary	kilograms	430,800	394,800	398,523 [r]	373,300 [r]	340,500
Iron and steel:						
Ore and concentrate:						
Gross weight	thousand metric tons	33,707	34,757	36,484	38,086	39,322
Fe content (62%-65%)	do.	21,570	22,240	23,200	24,200	24,800
Metal:						
Pig iron	do.	6,292 [r]	5,820 [r]	5,823 [r]	6,234	6,011
Direct-reduced iron	do.	1,526 [r]	1,556 [r]	1,702 [r]	1,542	1,633
Ferroalloys, electric arc furnace:						
Chromium ferroalloys	do.	2,574 [r]	2,141	2,351	2,813 [r]	2,965
Ferromanganese	do.	597	524	619	607 [r]	612
Ferrosilicon	do.	109	108	142	135 [r]	141
Ferrovanadium[e]	do.	18	18	25	27 [r]	25
Silicomanganese[e]	do.	238	220	273	301 [r]	310
Silicon metal	do.	41	39	43	49 [r]	51
Other	do.	30	64	85	80	80 [e]
Total[e]	do.	3,610 [r]	3,110 [r]	3,540 [r]	4,010 [r]	4,180
Steel:						
Crude	do.	8,481	8,821	9,100	9,481 [r]	9,504
Stainless		436	440	550	643	718
Lead:						
Concentrate, Pb content		75,262	50,771	49,444	39,941	37,485
Refined, secondary		46,200	53,000	60,900 [r]	64,900 [r]	64,100
Manganese:						
Ore and concentrate, gross weight:						
Metallurgical:						
More than 48% manganese	thousand metric tons	2,047	2,082	1,600	1,619	1,988
45% to 48% manganese	do.	302	--	728	178	372
40% to 45% manganese	do.	235	326	19	783	1,041
30% to 40% manganese	do.	1,029	832	955	905	789
Total	do.	3,613	3,240	3,302	3,485	4,190
Chemical, 35% to 65% manganese dioxide	do.	22	26	20	16	17
Grand total	do.	3,635	3,266	3,322	3,501	4,207
Metal, electrolytic[e]	do.	40	40	40	40	40
Nickel:						
Mine output, concentrate, nickel content[e]		36,616	36,443	38,546	40,842	39,853
Metal, electrolytic		30,900	30,500 [e]	31,646	40,800 [r]	39,900

See footnotes at end of table.

TABLE 1--Continued
SOUTH AFRICA: PRODUCTION OF MINERAL COMMODITIES[1]

(Metric tons unless otherwise specified)

Commodity		2000	2001	2002	2003	2004[p]
METALS--Continued						
Platinum-group metals:						
Iridium	kilograms	NA	NA	3,682	6,444	5,988
Platinum	do.	114,459	130,307	132,897 [r]	148,348	159,862
Palladium	do.	55,818	62,601	63,758 [r]	70,946	78,029
Rhodium	do.	12,067	13,507	15,175 [r]	16,816	16,743
Ruthenium	do.	19,427	19,329	21,022 [r]	23,537	25,531
Other[2]	do.	4,999	4,169	107 [r]	59	3
Total	do.	206,770	229,913	236,641 [r]	266,150	286,156
Silver	do.	144,143	109,570	113,142 [r]	79,817 [r]	71,600
Titanium:[e]						
Ilmenite concentrate	thousand metric tons	1,800	1,750	1,800	2,000	1,900
Rutile concentrate	do.	130	120	120	150	150
Total	do.	1,930	1,870	1,920	2,150	2,050
Titaniferous slag[3]	do.	1,057	1,090	1,150	1,350	1,300
Uranium oxide		1,015	1,065	998	894 [r]	888
Vanadium, vanadium metal content		18,021	18,184	25,227	27,172 [r]	23,302
Zinc:						
Concentrate:						
Gross weight		116,100	113,400	118,900	103,100	80,000 [e]
Zn content		63,590 [r]	61,560 [r]	64,580 [r]	41,400 [r]	32,310
Metal, smelter, primary		103,000	109,000	111,000 [r]	113,000 [r]	104,000
Zirconium concentrate (baddeleyite and zircon)[e]		253,000	245,000	274,000	300,000	302,000 [4]
INDUSTRIAL MINERALS						
Andalusite		182,674	193,225	165,087 [r]	164,921 [r]	234,625
Asbestos, chrysotile		18,782	13,393	--	6,218	--
Barite		1,628	--	--	--	--
Cementitious products:						
Cement, finished product, sales	thousand metric tons	7,971	8,036	8,525	8,883	10,500 [e]
Granulated slag, fly ash, and others, sales	do.	1,020	1,129	1,099	1,280	1,510 [e]
Total	do.	8,991	9,165	9,624	10,163	12,010
Clays:						
Attapulgite		10,287	9,299	13,288 [r]	14,585	20,419
Bentonite		90,100 [r]	108,300 [r]	101,100 [r]	145,060	55,859
Fire clay		112,637	141,303	101,150	90,604	133,258
Flint clay, raw and calcined		47,256	50,848	41,963	53,279	53,367
Kaolin		89,200 [r]	83,500 [r]	86,700 [r]	86,365 [r]	81,901
Brick clay, local sales	thousand metric tons	5,347	5,823	6,203	7,593	9,360
Diamond, natural:						
Gem	thousand carats	4,316	4,465	4,350	5,144	5,800 [e]
Industrial	do.	6,474	6,698	6,526	7,540	8,500 [e]
Total	do.	10,790	11,163	10,876	12,684	14,293
Feldspar		66,774	66,736	57,197	57,738	53,044
Fluorspar:						
Acid-grade		201,737	272,068	216,000 [r, e]	221,000 [r]	250,000 [e]
Metallurgical-grade		10,618	14,319	11,000 [r, e]	14,000 [r]	15,000 [e]
Total		212,355	286,387	227,000 [r]	235,000	265,000
Gemstones, semiprecious, Tiger's eye[e]	kilograms	80,000	80,000	-- [r, 4]	-- [r, 4]	-- [e]
Gypsum, crude		413,105	382,830	421,861 [r]	394,069	452,271
Industrial or glass sand (silica)	thousand metric tons	2,138	2,132	2,262	2,312	2,174
Lime	do.	1,391	1,615	1,585 [r]	1,518 [r]	1,738
Magnesite, crude		63,000 [r]	36,500 [r]	87,200 [r]	86,100 [r]	87,000 [e]
Mica, scrap and ground		708	937	880 [r]	1,003	901
Nitrogen, N content of ammonia		560,200	505,900	491,900	493,200	459,100
Perlite[e]		400	400	400	400	400

See footnotes at end of table.

TABLE 1--Continued
SOUTH AFRICA: PRODUCTION OF MINERAL COMMODITIES[1]

(Metric tons unless otherwise specified)

Commodity		2000	2001	2002	2003	2004[p]
INDUSTRIAL MINERALS--Continued						
Phosphate rock:						
Gross weight	thousand metric tons	2,796	2,550	2,803	2,643	2,735
Phosphorus pentoxide content	do.	1,083	995	1,086	1,030	1,070
Pigments, mineral, natural:						
Ochers		550	801	143	608	360
Oxides		80	51	109	156	152
Total		630	852	252	764	512
Salt		345,632	353,998	429,429 [r]	441,306 [r]	394,775
Silica	thousand metric tons	2,137	2,127	2,239 [r]	2,448 [r]	2,388
Sodium sulfate, natural		49,712	57,759	53,793	52,813	56,267
Stone, n.e.s.:						
Dimension:						
Granite and norite[5]		952,200 [r]	846,700 [r]	705,800 [r]	461,300 [r]	527,100
Slate		24,952	40,984	24,386	40,700 [r]	47,500
Crushed and broken:						
Limestone and dolomite	thousand metric tons	19,279 [r]	18,946 [r]	20,738 [r]	21,267 [r]	21,961
Quartzite	do.	7,965	7,412	318	--	--
Shale:						
For cement	do.	294	243	275	345	357
Other[5]	do.	7,358	67	67	49	50 [e]
Total	do.	7,652	310	342	394	407 [e]
Aggregate and sand, n.e.s.	do.	28,597 [r]	27,632 [r]	28,916 [r]	32,587 [r]	44,437
Sulfur:						
S content of pyrite (53.45%)	do.	146	150	183	176 [r]	165
Byproduct:						
Metallurgy	do.	100 [e]	265 [e]	179 [r]	174 [r]	180
Petroleum	do.	202	123	170 [r]	264 [r]	288
Total	do.	448	538	532 [r]	614	633
Talc and related materials:						
Talc		5,600	3,030	2,511	6,719	8,115
Pyrophyllite (wonderstone)		11,989	14,047	15,587	14,350	28,777
Vermiculite		208,835	156,632	210,000	182,802 [r]	196,893
MINERAL FUELS AND RELATED MATERIALS						
Coal (saleable product):						
Anthracite	thousand metric tons	1,618	1,607 [r]	1,305	1,206	1,247
Bituminous	do.	222,500	221,882	218,895	238,105	241,500
Total	do.	224,118	223,489	220,200	239,311	242,747
Natural gas	million cubic meters	2,088	1,800 [e]	2,000 [e]	2,500 [e]	2,500 [e]
Petroleum:[6]						
Crude	thousand 42-gallon barrels	6,606	13,870	10,950	4,068	6,769
Refinery products:						
Liquefied petroleum gases	do.	4,000	3,758 [r]	3,677 [r]	3,700 [r, e]	3,700 [e]
Gasoline	do.	67,900	67,796 [r]	73,077 [r]	73,000 [r, e]	73,000 [e]
Jet fuel	do.	13,900	13,829 [r]	16,726 [r]	17,000 [r, e]	17,000 [e]
Kerosene	do.	11,700	11,108 [r]	4,754 [r]	4,800 [r, e]	4,800 [e]
Distillate fuel oil	do.	51,500	53,339 [r]	59,620 [r]	60,000 [r, e]	60,000 [e]
Residual fuel oil	do.	34,700	32,221 [r]	34,452 [r]	34,000 [r, e]	34,000 [e]
Other, includes lubricants and greases[e]	do.	18,250 [4]	19,500 [r]	20,800 [r]	21,000 [r, e]	21,000 [e]
Total[e, 7]	do.	201,950 [4]	202,000	213,000 [r]	214,000 [r, e]	214,000 [e]

[e]Estimated; estimated data are rounded to no more than three significant figures; may not add to totals shown. NA Not available. [p]Preliminary. [r]Revised. -- Zero.

[1]Table includes data available through January 24, 2006.

[2]Difference between total production reported by the South African Department of Minerals and Energy, Mineral Development Branch, Mineral Economics Directorate and palladium, platinum, and rhodium supplies (shipments) reported in Johnson and Matthey Annual Platinum Review. Includes iridium and ruthenium production plus excess palladium, platinum, and rhodium inventory.

[3]Except for about 45,000 metric tons per year of slag derived from titaniferous magnetite by Highveld Steel and Vanadium Corp. Ltd., titaniferous slag is all from the smelting of ilmenite and likely represents most of that mineral's production, for which data are unavailable.

TABLE 1--Continued
SOUTH AFRICA: PRODUCTION OF MINERAL COMMODITIES[1]

[4]Reported figure.
[5]Converted from reported cubic meters by using 1 cubic meter=2.7 tons.
[6]In addition, Sasol Ltd. produced about 67 million barrels per year of synthetic liquid petroleum fuels from coal.
[7]Excludes refinery fuel and losses.

Source: Mineral Economics Directorate, South Africa Department of Minerals and Energy.